Alpine Entomology 9 2025, 5–28 | DOI 10.3897/alpento.9.147831

PENSOFT

Alpine Entomology

A review of *Limbodessus* Guignot, 1939 from New Guinea, with description of eight new tropical-alpine species (Coleoptera, Dytiscidae, Bidessini)

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https://zoobank.org/15F39A4A-E56E-41F1-860B-90B05ABF06E8

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Academic editor: Yannick Chittaro ♦ **Received** 24 January 2025 ♦ **Accepted** 8 May 2025 ♦ **Published** 5 June 2025

Abstract

The genus *Limbodessus* Guignot, 1939 from New Guinea is reviewed. Eight new species are described from the Central Mountain Range of New Guinea, from altitudes of 1,800 up to 3,500 m above sea level: *Limbodessus aipo* **sp. nov.**, *L. aldente* **sp. nov.**, *L. elit* **sp. nov.**, *L. habbema* **sp. nov.**, *L. juliana* **sp. nov.**, *L. konoensis* **sp. nov.**, *L. paniai* **sp. nov.**, and *L. wilhelmina* **sp. nov.** *Limbodessus skalei* Hendrich, Surbakti & Balke, 2020, described from Waigeo Island, is recorded for the first time for New Guinea. All 13 species are illustrated. They can be separated from each other by size, body shape, dorsal coloration, punctation of dorsal surface, but predominantly by the form of the male and female antennomeres and the form of male genitalia. A modified key is presented, and the habitats of most species are illustrated in detail.

Key Words

Alpine New Guinea, diversity, diving beetles, peatlands, undescribed species

Introduction

The diving beetle genus *Limbodessus* Guignot (1939) contains 81 described species, mostly distributed in the Australasian region, only one species reaches the Palearctic in Japan (Balke and Satô 1995; Balke and Ribera 2004; Nilsson and Hájek 2024).

The epigean Australian species were last revised by Watts and Leijs (2005), five species from New Guinea were treated in Balke et al. (2015); Hendrich et al. (2020) and Surbakti et al. (2023). The description of *L. moni* Surbakti, Balke & Hendrich, 2023 from the Grasberg Mine represented the altitudinal record of a diving beetle in New Guinea (ca. 3,970 m a.s.l.). However, the majority of *Limbodessus* species was described from underground waters in Western and South Australia (Eberhard et al. 2016).

The epigean species prefer shallow, stagnant water bodies or densely vegetated backflows and marginal areas of slow-flowing streams, even in subalpine to alpine grasslands in New Guinea, New Zealand and Australia (Ordish 1966; Balke and Ribera 2004; Watts and Leijs 2005; Balke et al. 2015; Surbakti et al. 2023). The biogeographic and ecological evolution of *Limbodessus* was recently reconstructed by Villastrigo et al. (2024), who proposed that the genus' diversification was triggered by

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major landscape and climatic changes in the region over the past 20 million years.

Until recently, the high-altitude fauna of New Guinea, located in the transitional area between the Oriental and the Austro-Pacific regions, remained the big unknown. Here, we 1) taxonomically revise montane to alpine New Guinean *Limbodessus* and 2) summarize what is known about their habitats and distribution.

Materials and methods

Descriptions

Beetles were examined with a Leica M205C dissecting microscope with magnifications ranging from 10 to 160×. Male genitalia were studied and illustrated in dry conditions. Label data of type material are cited within quotation marks. The following abbreviations were used: TL (total body length), TL-H (total body length without head), and MW (maximum body width). Measurements were taken with a Leica M205C stereomicroscope.

Dissection of male genitalia

The diagnosis of the new species is primarily based on the morphology of male genitalia and female antennomeres. The terminology denoting the orientation of the genitalia follows Miller and Nilsson (2003). Prior to dissection, dry specimens were soften in hot water for 10 minutes. Genitalia were extracted by inserting an insect pin into the abdominal opening. The median lobe of the aedeagus and the parameres were disarticulated and mounted alongside with the specimen.

Photography

The description of morphological characters follows our previous work on *Limbodessus* beetles (e.g. Balke et al. 2015; Hendrich et al. 2020; Surbakti et al. 2023). Images were taken with a Canon EOS R camera. We used Mitutoyo 10 × (habitus) or 20 × (genital structures) ELWD Plan Apo objectives. These were attached to a Carl Zeiss Jena Sonnar 3.5/135 MC, used as a focus lens. Illumination was provided by three LED segments SN-1 from Stonemaster (https://www.stonemaster-onlineshop.de). Image stacks were generated with the Stackmaster macro rail (Stonemaster), and images were then assembled using Helicon Focus 4.77 on a MacPro with a Radeon 6800 XT GPU.

Codens

CLH Collection Lars Hendrich, Munich, Germany, property of NHMW

CNW Collection Leopold Wendlandt, Berlin, Germany

KSP Koleksi Serangga Papua, at the Biology Department of Universitas Cenderawasih (UNCEN), Wamena, Papua, Indonesia

MZB Museum Zoologicum Bogoriense, Cibinong, Indonesia

NHMW Naturhistorisches Museum Wien, Vienna, Austria

NMPC National Museum, Prague, Czech Republic

SAM South Australian Museum, Adelaide, South Australia, Australia

USNM Smithsonian National Museum of Natural History, Washington, USA

ZSM Zoologische Staatsammlung München, Munich, Germany

Results

Checklist of *Limbodessus* species from New Guinea

*= endemic

**L. aipo* sp. nov. Papua: Aipomek and Kono Highlands.
**L. aldente* sp. nov. Papua: Lake Habbema.
**L. alexanderi* Balke & Hendrich, 2015 Papua: N of Sugapa.
**L. baliem* Balke & Hendrich, 2015 Papua: Baliem Valley.
L. compactus (Clark, 1862). Oriental and Australasian realms.
**L. elit* sp. nov. Papua: Mt. Elit.
**L. habbema* sp. nov. Papua: Lake Habbema area.
**L. juliana* sp. nov. Papua: Mt. Juliana, Aipomek; PNG: Mt. Capella area.
**L. konoensis* sp. nov. Papua: Kono area, Mt. Elit, Lake Habbema area.
**L. moni* Surbakti, Balke & Hendrich, 2023. Papua, Mount Jaya (=Carstentz) area, N of Sugapa.
**L. paniai* sp. nov. Papua: Lake Paniai.
**L. skalei* Hendrich, Surbakti & Balke, 2020 West Papua: Waigeo and Vogelkop.
**L. wilhelmina* sp. nov. Papua: Lake Habbema area.

Altogether 13 species of *Limbodessus* are now known from New Guinea.

Description of new species

Limbodessus aipo sp. nov.

https://zoobank.org/511D41A3-256F-422F-91D9-E203D406B0A2

Figs 1A, 7A, 11A, 13A, 14, 17F, G

Type locality. Small peatland pool, along track from Aipomek to Langda, 3,550–3,600 m [140°05'E, 04°27'S], Papua, Indonesia.

Type material. ***Holotype***, male. "IRIAN JAYA: Aipomek Area [N Pass] Aipomek-Langda, 140°05'E

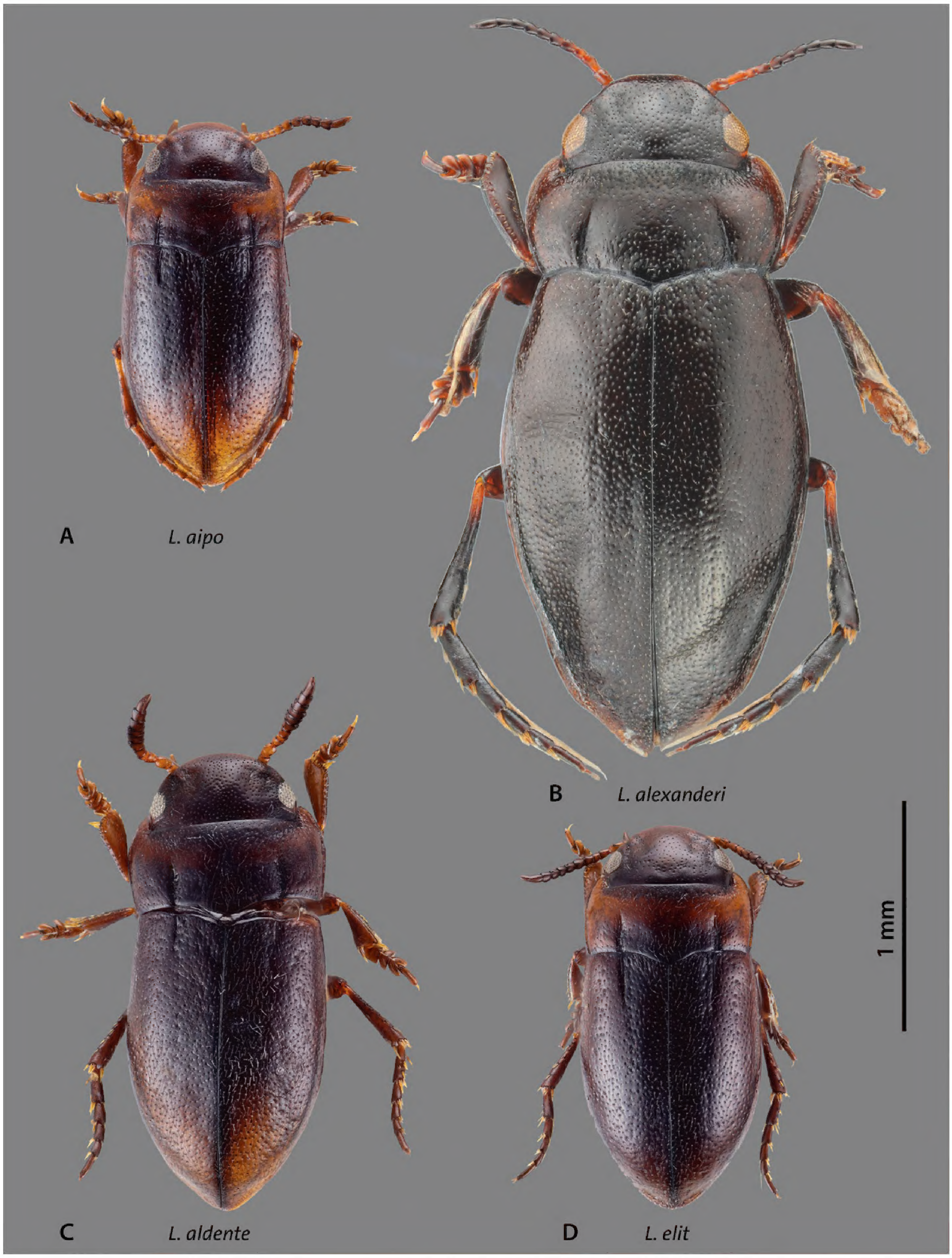

Figure 1. Habitus of *L. aipo* sp. nov., male (**A**); *L. alexanderi*, male (**B**); *aldente* sp. nov., female (**C**); *L. elit* sp. nov., male (**D**).

04°27'S, 22.-24.8.1992, 3550–3600m, leg. M. Balke (20–22)" [IR92#20-22], "Holotype *Limbodessus aipo* sp. nov. Balke et al. 2025" [red printed label] (NHMW).

***Paratypes* (96)**: 46 exs., same label data as holotype (NHMW, KSP, ZSM); 37 exs., "IRIAN JAYA: Aipomek area, 140°06'E 04°27'S, 27.8.1992, 3500m [S pass] Aipomek-Langda, leg. Balke (23)"; 13 exs., "Irian Jaya, ca. 139°47'E 04°19'S [Valley below Mt. Orom, trek Kono-Angguruk, 2800m], 5–6.10.1993, leg. Balke (29/30)" [IR93#29-30] (NHMW, KSP,

ZSM). All paratypes are provided with a red printed paratype label.

Measurements. Holotype: TL = 1.55 mm; TL-H = 1.50 mm; MW = 0.70 mm. Paratypes: TL = 1.60–1.70 mm; TL-H = 1.50–1.60 mm; MW = 0.65–0.70 mm.

Description. Smaller species, body elongate, appearing somewhat parallel-sided, with slight discontinuity in lateral outline between pronotum and elytron. Cervical or sutural line absent. Pronotal and elytral stria present and distinct, long (Fig. 1A).

Color. Body dark brown to blackish. Clypeus and pronotum anteriorly, medially and laterally slightly paler: dark ferruginous to castaneous brown. Antennomeres 1–5/6 dark ferruginous, 6–11 darker, blackish; in a few specimens paler however, completely ferruginous. Legs dark ferruginous (Fig. 1A). Ventral side chiefly black. Prosternum, epipleura and sternite 7 ferruginous.

Sculpture. Head moderately densely punctate; punctation on clypeus and vertex sparse; with distinct microreticulation of small polygonal meshes. Size of punctures equals diameter of meshes. Pronotum with moderately dense punctation along fore-margin; other parts with sparse punctation. Size of punctures as on head. Elytron with moderately dense and evenly distributed punctation; between punctures with almost invisible larger polygonal meshes. Ventral side with few punctures, shiny; only sternite 7 with distinct microreticulation. Epipleura narrow posteriorly, disappeared at level of sternite 6, sternite 7 with border.

Structures. Metacoxal lines anteriorly diverging and not reaching posterior margin of metaventrite.

Male. Pronotum with microreticulation of small polygonal meshes being confined to a medial portion, expanded laterally as far as level of striae. Elytron shiny, no microreticulation visible between punctures but a network of large polygonal meshes. Antenna moniliform due to globular form of antennomeres (Fig. 13A). Median lobe as in Fig. 7A, parameres as in Fig. 11A.

Female. Pronotum shagreened, dull. Elytron dull, distinctly shagreened between the punctures. Antenna moniliform due to globular form of antennomeres.

Etymology. Dedicated to the people inhabiting parts of the type area, i.e. the Aipo people. The name is a noun in the nominative standing in apposition.

Distribution. Aipomek-Langda and valley below Mt. Orom, trek Kono-Angguruk, in the Central Highlands of Papua (Fig. 14).

Differential diagnosis. *Limbodessus aipo* sp. nov. belongs to a group of smaller (TL = 1.55–1.90 mm) and almost blackish high alpine species. The new species is close to *L. aldente* sp. nov., *L. elit* sp. nov. and *L. wilhelmina* sp. nov. but can be separated from them by the form of the female antennae, which is moniliform due to globular form of antennomeres (Fig. 13A), the form of the median lobe (Fig. 7A, B, C), and the form of the parameres (Fig. 11A).

Habitat. Small puddles in alpine meadows (Fig. 17F, G).

Limbodessus aldente sp. nov.

https://zoobank.org/5A46F651-BFBE-4054-BBE4-E44B1904CD9D

Figs 1C, 12C, 13B, 14

Type locality. Small, mossy puddles, Mt. Trikora area, 3,450 m [138°43'E, 04°13'S], West Papua, Indonesia.

Type material. ***Holotype***, female: "IRIAN JAYA: Trikora Gebiet 19.-20.10.1993, Habbema [Lake] and Kali Oue Tal [Valley], ca. 138°43'E 04°13'S, 3450m, leg. M. Balke (39)", "Holotype *Limbodessus aldente* sp. nov. Balke et al. 2025" [red printed label] (NHMW).

Paratypes. 2 females with the same data as the holotype (NHMW, ZSM). Both paratypes are provided with a red printed paratype label.

Measurements. Holotype: TL = 1.90 mm; TL-H = 1.75 mm; MW = 0.80 mm. Paratypes: TL 1.80–1.90 mm, TL-H = 1.75–1.80 mm; MW = 0.80–0.85 mm.

Description. Rather small, elytra somewhat parallel-sided; body with distinct discontinuity in lateral outline between pronotum and elytron; pronotum cordiform, strongly narrowed posteriorly. Cervical or sutural line absent. Pronotal and elytral stria present and distinct (Fig. 1C).

Color. Body chiefly black. Clypeus anteriorly, pronotum anteriorly and laterally slightly paler: dark ferruginous to castaneous brown. Antennomeres 1–5/6 dark ferruginous, 6–11 darker, blackish. Legs dark ferruginous (Fig. 1C). Ventral side chiefly black. Prosternum, epipleura and sternite 7 ferruginous.

Sculpture. Head densely and evenly punctate; microreticulation indistinct; shiny. Pronotum with moderately dense punctation; discally sparser; microreticulate, also laterally. Elytron with moderately dense and evenly distributed punctation. Ventral side with few punctures, shiny; only sternite 7 with distinct microreticulation.

Structures. Metacoxal lines anteriorly diverging and not reaching posterior margin of metaventrite.

Male unknown.

Female. Elytron dull, with distinct microreticulation between punctures. Antenna stout with some antennomeres being conspicuously modified: 6–8 distinctly dilated, 9–11 slightly dilated (Figs 12C, 13B).

Etymology. Named for our friend Alexander Riedel, Munich, Germany, inventor of the "aldente" way to prepare keladi, a staple food in West Papua. The name is a noun in the nominative standing in apposition.

Distribution. Only known from the Lake Habbema area, in the Central Highlands of Papua (Fig. 14).

Differential diagnosis. *Limbodessus aldente* sp. nov. belongs to a group of smaller (TL = 1.55–1.90 mm) and almost blackish high alpine species. The new species is close to *L. aipo* sp. nov., *L. elit* sp. nov. and *L. wilhelmina* sp. nov. but can be separated from them by the form of the female antennae, which is stout with antennomeres being conspicuously modified: 6–8 distinctly dilated, 9–11 slightly dilated (Figs 12C, 13B).

Habitat. Small puddles in alpine meadows overgrown with mosses.

Limbodessus elit sp. nov.

https://zoobank.org/3AE8FEC1-F1CF-4D26-AF18-7130324CDB4F

Figs 1D, 7B, 10D, 11B, 13C, 14, 17A–D

Type locality. Mossy puddles in Alpine grassland, Mt. Elit area, Angguruk-Baliem, 3,400 m [139°17'E, 04°14'S], Papua, Indonesia.

Type material. ***Holotype***, male. "IRIAN JAYA: Angguruk-Baliem, 10.-11.10.1993, Mt. Elit, ca. 139°17'E 04°14'S, 3400m, leg. M. Balke (33)", "Holotype *Limbodessus elit* sp. nov. Balke et al. 2025" [red printed label] (NHMW).

***Paratypes* (30)**: 30 exs. with the same label data as the holotype (NHMW, KSP, ZSM). All paratypes are provided with a red printed paratype label.

Measurements. Holotype: TL = 1.80 mm; TL-H = 1.60 mm; MW = 0.80 mm. Paratypes: TL 1.70–1.85 mm; TL-H = 1.60–1.70 mm; MW = 0.80–0.85 mm.

Description. Rather small, body elongate-oval, with distinct discontinuity in lateral outline between pronotum and elytron. Cervical or sutural line absent. Pronotal and elytral stria present and distinct (Fig. 1D).

Color. Body dark-brown to blackish. Clypeus anteriorly, pronotum medially and laterally slightly paler: dark ferruginous to castaneous brown. Antennomeres 1–4 dark ferruginous, 5–11 darker, blackish. Legs dark brown; metatibiae and metatarsi blackish, metafemora castaneous (Fig. 1D). Ventral side chiefly black. Prosternum, epipleura and sternite 7 ferruginous.

Sculpture. Head moderately densely punctate; punctation on clypeus and apically sparse; with distinct microreticulation. Size of the punctures corresponds with diameter of meshes. Pronotum with moderately dense punctation along fore-margin; other parts with sparse punctation; microreticulation only medially expanded as far laterally as level of striae. Size of punctures as on head, laterally smaller. Elytron with moderately dense and evenly distributed punctation; between punctures with almost invisible larger polygonal meshes; punctures slightly larger than on head and pronotum. Ventral side with few punctures, shiny; only sternite 7 with distinct microreticulation.

Structures. Metacoxal lines anteriorly diverging and not reaching posterior margin of metaventrite.

Male. Elytron shiny, without microreticulation between punctures. Antenna stout. Median lobe as in Fig. 7B and parameres as in Fig. 10D, B.

Female. Elytron shiny, without microreticulation between punctures. Antenna stout but without conspicuous modifications (Fig. 13C).

Etymology. Named after the type locality, Mount Elit, a two-days walk from Wamena in the direction to Pronggoli. The name is a noun in the nominative standing in apposition.

Distribution. Only known from Mount Elit (Fig. 17A), in the Central Highlands of Papua (Fig. 14).

Differential diagnosis. *Limbodessus elit* sp. nov. belongs to a group of smaller (TL = 1.55–1.90 mm) and almost blackish high alpine species. The new species is close to *L. aipo* sp. nov., *L. aldente* sp. nov. and *L. wilhelmina* sp. nov. but can be separated from them by the form of the female antennae, which is stout without any conspicuous modifications (Fig. 13C), the form of the median lobe (Fig. 7B), and the form of the parameres (Figs 10D, 11B).

Habitat. In very shallow water at the edge of small puddles and pools in alpine meadows (Fig. 17B, C, D).

Limbodessus habbema sp. nov.

https://zoobank.org/16D11406-0142-488F-A929-FD4591AFF7BE

Figs 3A, B, C, 8D, 10C, 11F, 12D, E, 13F, 14, 16C

Type locality. Mossy puddles in Alpine grassland, Lake Habbema area, Angguruk-Baliem, 3,200 m [04°07'77S, 138°40'77E], Papua, Indonesia.

Type material. ***Holotype***, male: "Indonesia, Papua, Lake Habbema, pools, 3200m, 19.x.2011, 04.07.772S 138.40.773E, Balke leg. (PAP06)", "Holotype *Limbodessus habbema* sp. nov. Balke et al. 2025" [red printed label] (MZB).

Paratypes (322): 126 exs., with the same label data as the holotype (NHMW, KSP, ZSM); 70 exs., "IRIAN JAYA: Lake Habbema, 17.10.1993, 3250 m, ca. 138°40E 04°09'S, leg. M. Balke (37)" [IR93#37] (NHMW, ZSM); 1 ex., "IRIAN JAYA: Trikora Gebiet 19.-20.10.1993, Habbema [Lake] and Kali Oue Tal [Valley], ca. 138°43'E 04°13'S, 3450 m, leg. M. Balke (39)" (NHMW); 81 exs., "Papua, Lake Habbema, 3300m, 24.04, 2006, Tindige leg.", 3 specimens with printed green labels "3161", "3162", "3163" (ZSM); 11 exs., "Irian Jaya, Wamena E, Habbema lake, 4°07'S 138°40'E, 20.1.1999, leg. A. Weigel" (ZSM); 2 exs., "Indonesia, West Papua, Highland near Lake Habbema, Sphagnum-pools near the road, 3451 m, 4°06'32.8"S 138°38'54.2"E, 09.06.2022, N. Wendlandt leg." (CNW, ZSM); 19 exs., "Indonesia, West Papua, Lanny Jaya, Kecamatan Makki highland, peatland pools, 3013m, 4°01'13.7"S 138°35'34.0"E, 06.06.2022, N. Wendlandt leg." (CNW, ZSM); 18 exs., "Indonesia, West Papua, Lanny Jaya, Kecamatan Makki highland, peatland pools, 3170m, 4°02'25.0"S 138°36'20.5"E, 07.06.2022, N. Wendlandt leg." (CNW, ZSM); 11 exs., "Indonesia: Papua, Lake Habbema, Phyllodrom leg. 2001" (ZSM); 48 exs., "INDONESIA, Papua: Jayawijaya Distr., ca. 30 km W of Wamena, open wetland nr Habbema lake, 04°07.8'S, 138°40.7'E; 3330 m, J.Hájek & J.Šumpich leg., 5.ii.2015" (NMPC); 9 exs., "Indonesia: Papua, Lake Habbema, 3400m, viii.2018, -4.1460° 138.675°, Sumoked (Pap77)" (MZB, ZSM). All paratypes are provided with a red printed paratype label.

Measurements. Holotype: TL = 2.7 mm; TL-H = 2.5 mm; MW = 1.2 mm. Paratypes: TL 2.25–2.8 mm, TL-H = 2.15–2.65 mm, MW = 1.1–1.2 mm.

Description. Large, body elongate-oval, with distinct discontinuity in lateral outline between pronotum and elytron. Sutural line absent; cervical line absent, but some specimens with a cervical dense row of punctures. Pronotal and elytral stria present and distinct (Fig. 3A, B, C).

Color. Head black, clypeus anteriorly paler, dark brown. Pronotum with anterior half, laterally, and basal angles dark

ferruginous to dark yellowish, baso-medially darker, dark brown to blackish; in one specimen almost entirely yellowish. Elytron dark brown to dark ferruginous; in some specimens posteriorly with distinct dark yellowish and dark brown color pattern. Antennomeres 1–4/5 dark ferruginous, 6–11 darker, blackish. Legs dark ferruginous; mid of metatibiae and metatarsi darker, blackish (Fig. 3A). Ventral side chiefly black. Prosternum, epipleura and sternite 7 ferruginous.

Sculpture. Head densely punctate; a cervical dense row of punctures visible, vertex almost impunctate but with distinct microreticulation only. Size of punctures on frons equal of size of meshes of microreticulation but decreases towards clypeus. Pronotum with moderately dense punctation along fore-margin; size of punctures as on frons; otherwise with fine and sparse punctation only. Elytron with moderately dense and evenly distributed punctation that may be faint on antero-sutural part. Ventral side with few punctures, shiny; only sternite 7 with distinct microreticulation.

Structures. Metacoxal lines anteriorly diverge and do not reach posterior margin of metaventrite.

Male. Shiny. Distinct microreticulation only posteriorly of cervical row of punctures on head; indistinct microreticulation of that line anteriorly. Antennomeres rather long and narrow; antenna thus not appearing stout (Figs 12D, E, 13F). Median lobe as in Fig. 8D and parameres as in Figs 10C, 11F.

Female. Dull. Head with faint microreticulation, pronotum and elytron dull with distinct microreticulation between punctures. Antenna distinctly clubbed due to lateral expansion of antennomeres 3–11 (Figs 12D, E, 13F). Some females with broadly enlarged antennomeres (Fig. 3C).

Etymology. Named after the Habbema lake, where the species was discovered. The name is a noun in the nominative standing in apposition.

Distribution. Only known from the Lake Habbema area in the central mountain range of Papua (Fig. 14).

Differential diagnosis. The new species belongs to a group of larger (TL = 2.25–3.0 mm) and almost blackish high alpine species. *Limbodessus habbema* sp. nov. is close to *L. alexanderi* and *L. juliana* sp. nov. but can be separated from them by the form of the female antennae, which is distinctly clubbed due to lateral expansion of antennomeres 3–11 (Figs 12D, E, 13F), the form of the median lobe (Fig. 8D), and the form of the parameres (Figs 10C, 11F).

Habitat. Small puddles in alpine meadows (Fig. 16C).

Limbodessus juliana sp. nov.

https://zoobank.org/C1EED587-1D73-4B82-831D-16151F0E5AA3

Figs 4A, 7D, 9D, 10E, I, 11E, 13H, 14, 17F, G, 18A, B

Type locality. Mossy puddles in Alpine grassland, Mt. Juliana area, Sab-me Valley, 3,400–3,500 m [140°17'E, 04°27'S], Papua, Indonesia.

Type material. ***Holotype***, male: "IRIAN JAYA, Mt. Juliana Gebiet, 16.-17.9.1993, Sab-me Tal, 3400–3500m, ca. 140°17'E 04°27'S, leg. M. Balke (14)", "Holotype *Limbodessus juliana* sp. nov. Balke et al. 2025" [red printed label] (NHMW).

Paratypes (573): 169 exs., with the same label data as the holotype; 19 exs., "IRIAN JAYA: Aipomek Area [N Pass] Aipomek-Langda, 140°05'E 04°27'S, 22.-24.8.1992, 3550–3600m, leg. M. Balke (20)" [IR92#20] (MZB, NHMW, KSP, ZSM); 216 exs., "IRIAN JAYA: Aipomek Area [N Pass] Aipomek-Langda, 140°06'E 04°27'S, 22.-24.8.1992, 3550–3600m, leg. M. Balke (21)" [IR92#21] (NHMW, KSP, ZSM); 136 exs., "IRIAN JAYA: Aipomek Area [N Pass] Aipomek-Langda, 140°05'E 04°27'S, 22.-24.8.1992, 3550–3600m, leg. M. Balke (20–22)" [IR92#20-22] (NHMW, KSP, ZSM); 3 exs., "IRIAN JAYA: Aipomek Area [South Pass], 140°06'E 04°27'S, 27.8.1992, 3500m, Aipomek-Langda, leg. Balke (26)" (NHMW, ZSM); 24 exs., "IRIAN JAYA: Aipomek Area [N Pass], 140°05'E 04°27'S, 22.-24.8.1992, 3800m, Aipomek-Langda, leg. Balke (26)" [IR92#26] (NHMW, KSP, ZSM); 6 exs., "W. Neuguinea, Pass nach Langda, 3900m, vi.1979, P. Blum leg." (ZSM). All paratypes are provided with a red printed paratype label.

Measurements. Holotype: TL = 2.6 mm; TL-H = 2.3 mm; MW = 1.2 mm. Paratypes: TL = 2.6–2.7 mm, TL-H = 2.4–2.5 mm, MW = 1.1–1.5 mm.

Description. Body rather elongate-oval, with distinct discontinuity in lateral outline between pronotum and elytron; apically broadly rounded to truncate. No cervical or sutural line. Pronotal stria present and distinct, no elytral stria visible (Fig. 4A).

Color. Body chiefly black. Clypeus anteriorly, pronotum anteriorly and laterally slightly paler: dark castaneous brown. Antenna chiefly blackish. Legs dark castaneous brown (Fig. 4A). Ventral side chiefly black, sternite 7 dark ferruginous.

Note: The first author also collected/ observed paler specimens which appear mature. The body is then castaneous brown to dark ferruginous, elytron sometimes darker medially.

Sculpture. Head moderately densely punctate; punctation on clypeus and apically sparser; microreticulate. Punctures of same size as meshes of microreticulation. Pronotum with moderately dense punctation along fore-margin; rest sparsely punctate especially on disc. Size of punctures as on head; discally distinctly smaller. Elytron with moderately dense and evenly distributed punctation; between punctures with almost invisible larger polygonal meshes. Ventral side with few punctures, shiny; only sternite 7 with distinct microreticulation.

Structures. Metacoxal lines slightly diverge anteriorly and do not reach posterior margin of metaventrite; with concavity between lines.

Male. Pronotum and elytra shiny, without mircoreticulation. Antenna stout (Fig. 13H). Median lobe as in Fig. 7D and parameres as in Figs 10E, I, 11E.

Female. Pronotum and elytron dull, with distinct microreticulation between punctures. Antenna stout but without conspicuous modifications (Fig. 13H).

Etymology. The name refers to Mount Juliana (Fig. 18B), one of the localities of this species. The name is a noun in the nominative standing in apposition.

Distribution. Only know from the type locality, Sab-me Valley below Mt. Orom, Papua (Fig. 14).

Differential diagnosis. The new species belongs to a group of larger (TL = 2.25–3.0 mm) and almost blackish high alpine species. *L. juliana* sp. nov. is close to *L. alexanderi* and *L. habbema* sp. nov. but can be separated from them by the form of the female antennae, which is stout without any conspicuous modifications (Fig. 13H), the form of the median lobe (Fig. 7D), and the form of the parameres (Figs 10E, 11E).

Habitat. Small puddles in alpine meadows, with dense stands of submerged mosses and grasses (Figs 17F, G, 18A).

Limbodessus konoensis sp. nov.

https://zoobank.org/4A72619E-8F68-4A2E-97B3-D4E37DBEDC43

Figs 2C, 8A, 10F, 11D, 13J, 14, 16C, 17B, C, D, 18D, E

Type locality. Mossy puddles in Alpine grassland, near Lake Habbema, 3,400 m [138°67'E, 04°14'S], Papua, Indonesia.

Type material. ***Holotype***, male: "Indonesia: Papua, Lake Habbema, 3400m, viii.2018, -4.1460° 138.675°, Sumoked (Pap77)", "Holotype *Limbodessus konoensis* sp. nov. Balke et al. 2025" [red printed label] (MZB).

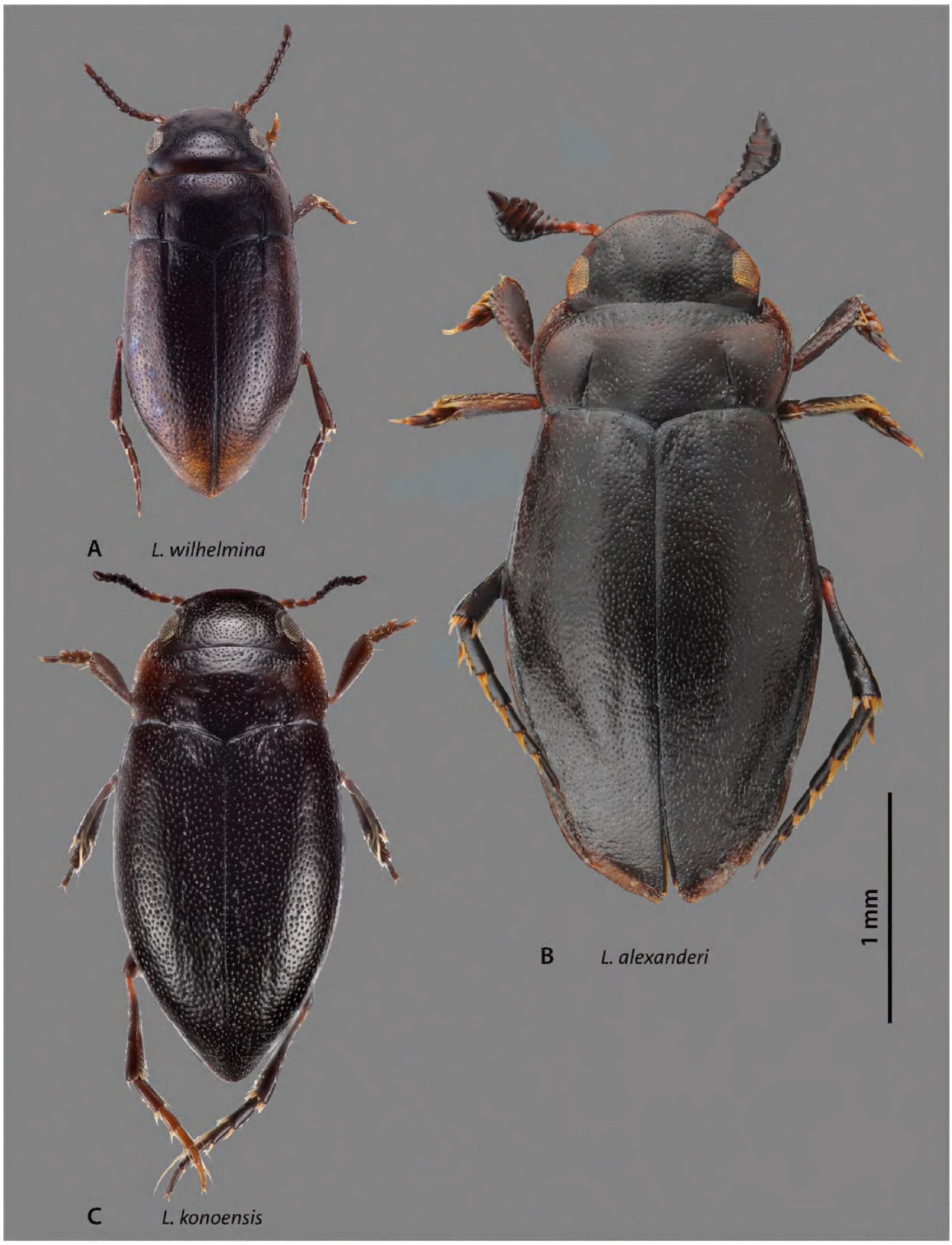

Figure 2. Habitus of *L. wilhelmina* sp. nov., male (**A**); *L. alexanderi*, female (**B**); *L. konoensis* sp. nov., male (**C**).

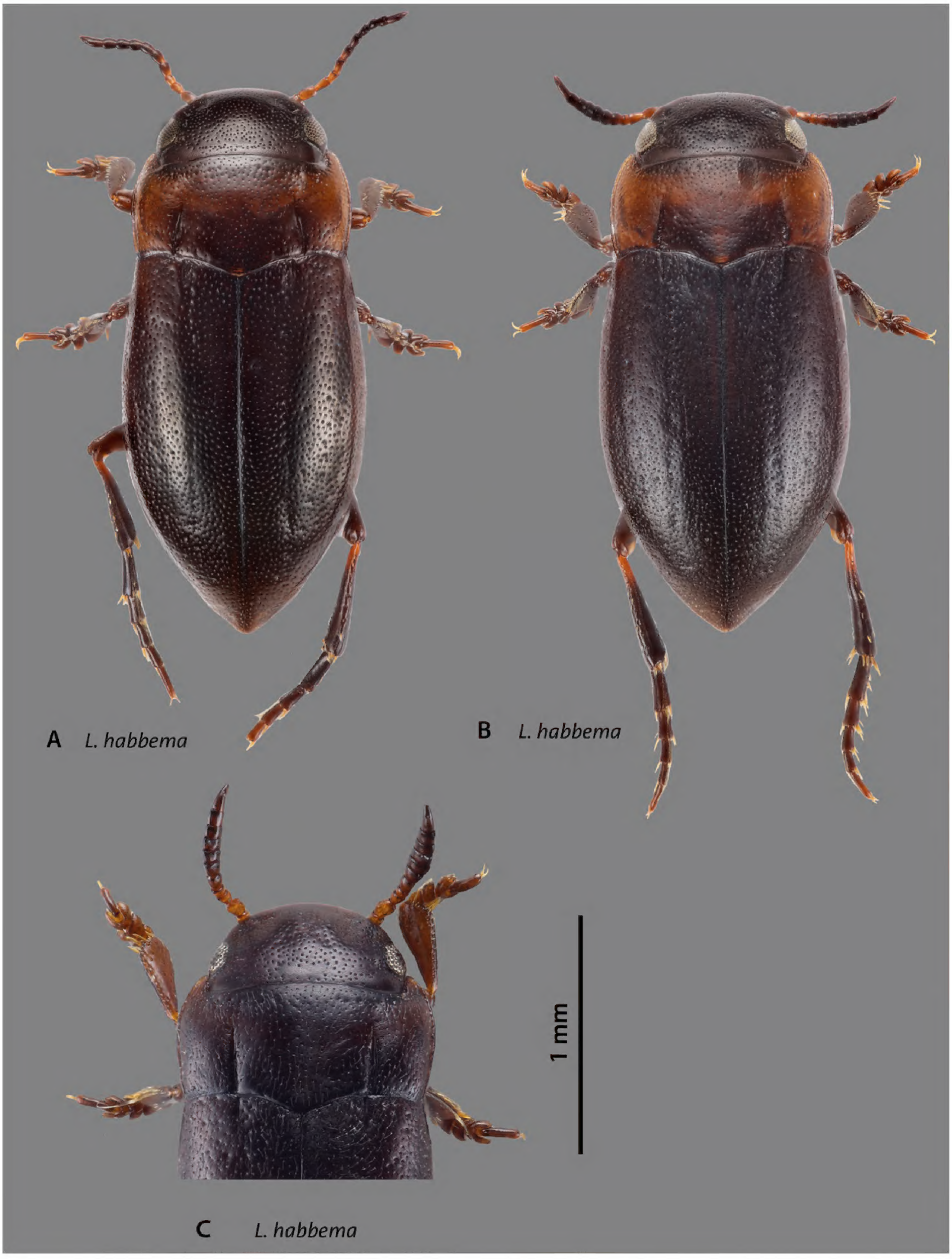

Figure 3. Habitus of *L. habbema* sp. nov., male (**A**); *L. habbema* sp. nov., female, with enlarged antennomeres (**B**); *L. habbema* sp. nov., female with broadly enlarged antennomeres (**C**).

Paratypes (722): 69 exs., with the same label data as the holotype (NWM, ZSM); 72 exs., "Indonesia, Irian Jaya, 10ix.1992, Kono-Angguruk 2800m, 139°47'E 04°19'S, leg. Balke (45); 71 exs., "IRIAN JAYA: 15.9.1992, Gunung Elit, 3450m, 139°17'E 04°14'S, leg. Balke (50)" [IR92#50] (NWM, ZSM); 220 exs.,

Figure 4. Habitus of *L. juliana* sp. nov., male (**A**); *L. moni*, female (**B**); *L. moni*, male (**C**).

"IRIAN JAYA: Angguruk-Baliem, 10.-11.10.1993, Mt. Elit, ca. 139°17'E 04°14'S, 3400m, leg. M. Balke (33)" [IR93#33]; 35 exs., "Irian Jaya: 18.10.1993 Trikora Area Fuß des Mt. Trikora, ca. 138°43'E 04°13'S, 3200m, leg. M. Balke (38)" [IR93#38] (NHMW, ZSM); 231 exs., "IRIAN JAYA: Trikora Gebiet, 19.-20.10.1993, Habbema [Lake] and Kali Oue Tal [Valley], ca. 138°43'E 04°13'S, 3450 m, leg. M. Balke (39)" (NHMW, ZSM); 9 exs., "IRIAN JAYA: 21.10.1993, Habbema-Gebiet Pass zum Ibele Tal [pass to Ibele Valley], ca. 138°45'E 04°07'S, 3300m, leg. M. Balke (40)" [IR93#40] (NHMW, KSP, ZSM); 6 exs., "INDONESIA, Papua: Jayawijaya Distr., ca. 30 km W of Wamena, open wetland nr Habbema lake, 04°07.8'S, 138°40.7'E; 3330 m, J.Hájek & J.Šumpich leg., 5.ii.2015" (NMPC); 9 exs., "Irian Jaya, Wamena, Jayawijaya Prov., W. Gunung Elit, 3300m, 15.IX.1991, A. Riedel leg." (CLH, ZSM). All paratypes are provided with a red printed paratype label.

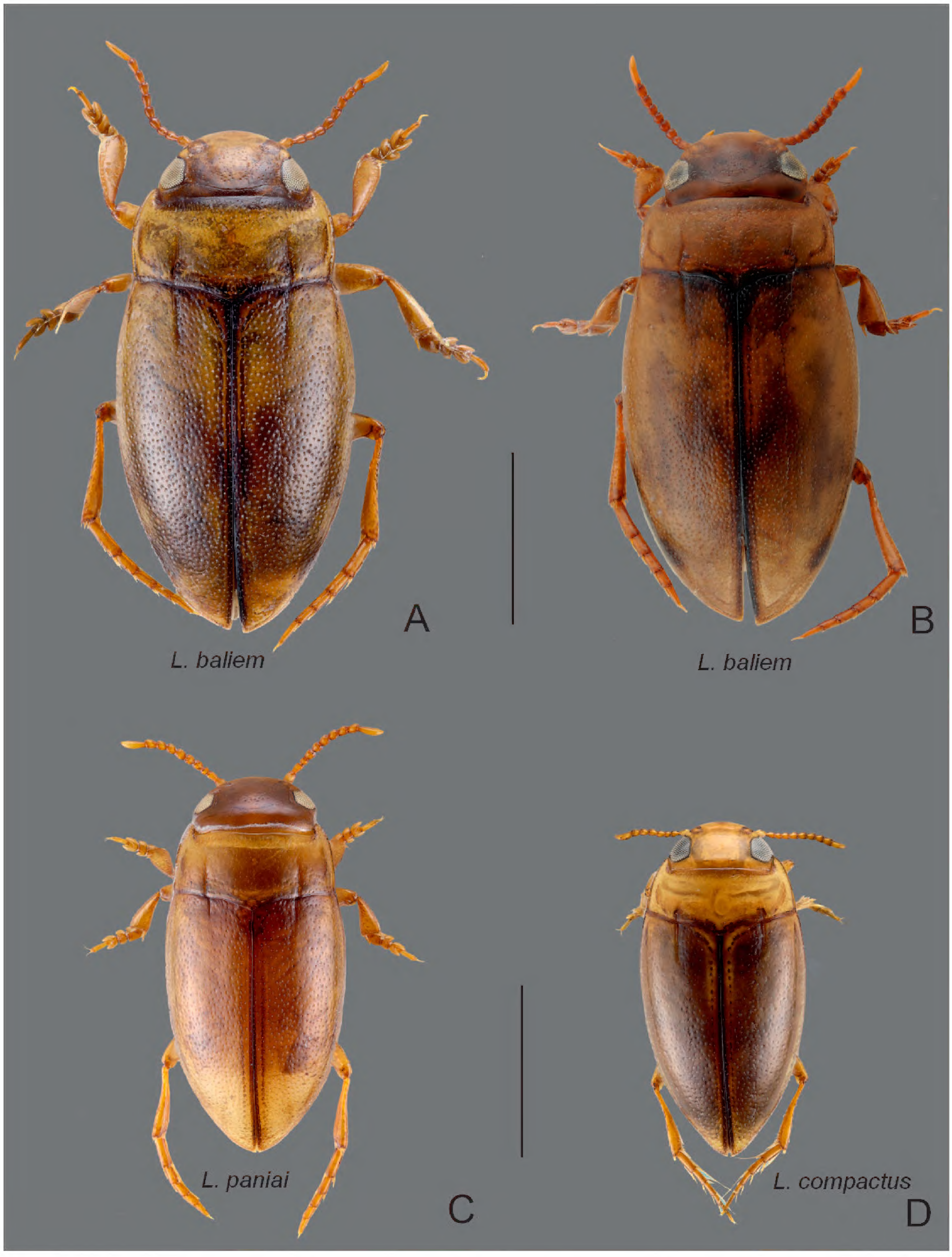

Figure 5. Habitus of *L. baliem*, male (**A**); *L. baliem*, female (**B**); *L. paniai* sp. nov., male (**C**); *L. compactus* (**D**). Scale bars: 1 mm.

Measurements. Holotype: TL = 2.3 mm; TL-H = 2.1 mm; MW = 1.1 mm. Paratypes: TL 2.35–2.5 mm, TL-H = 2.1–2.2 mm; MW = 1.0–1.1 mm.

Description. Medium sized, body elongate-oval; apically slightly drop-shaped; with distinct discontinuity in lateral outline between pronotum and elytron. Cervical or sutural line absent. Pronotal and elytral stria present and distinct (Fig. 2C).

Color. Body chiefly black. Clypeus anteriorly, pronotum medially and laterally slightly paler: dark

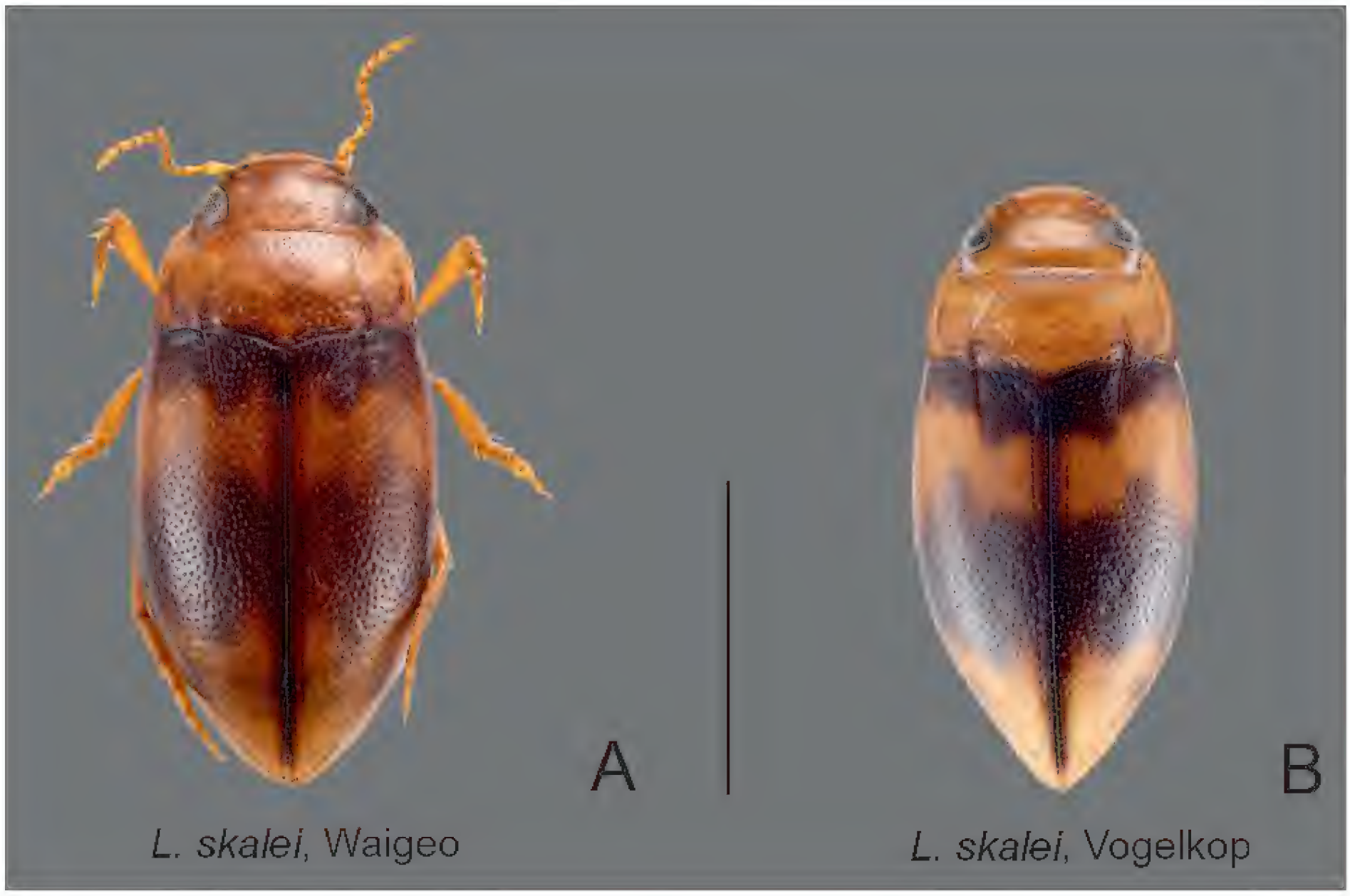

Figure 6. Habitus of *L. skalei*, male, paratype (**A**); *L. skalei*, female, Vogelkop (**B**). Scale bar: 1 mm.

ferruginous. Antenna chiefly blackish. Legs dark ferruginous (Fig. 2C). Ventral side chiefly black. Prosternum, epipleura and sternite 7 ferruginous.

Note: The first author frequently collected/ observed paler specimens that appear mature: head dark castaneous; pronotum anteriorly dark castaneous, rest dark yellow; elytron anterior half dark yellow, posterior half dark castaneous.

Sculpture. Head moderately densely punctate, densest on frons; punctation on clypeus and vertex sparse; with indistinct microreticulation of small polygonal meshes. Punctures slightly larger than meshes. Pronotum with moderately dense punctation along fore-margin; rest sparsely punctate especially on disc; an indistinct microreticulation visible discally. Size of punctures as on head, discally distinctly smaller. Elytron with moderately dense and evenly distributed punctation; between punctures with hardly visible larger polygonal meshes. Ventral side with few punctures, shiny; only sternite 7 with distinct microreticulation.

Structures. Metacoxal lines anteriorly diverge and do not reach posterior margin of metaventrite.

Male. Elytron rather shiny, sometimes with antero-sutural microreticulation. Antenna stout (Fig. 13J). Median lobe as in Fig. 8A and parameres as in Figs 10F, 11D.

Female. Generally identical to male in habitus; elytron sometimes dull, with distinct microreticulation between punctures. The corresponding author has seen 4 specimens with strong pronotal and elytral microreticulation from Mount Elit (IR92#50). Antenna stout but without conspicuous modifications.

Etymology. Named after Kono village, situated at the easternmost limit of the species' range. The name is an adjective in the nominative singular.

Distribution. From the valley below Mt. Orom, Mount Elit, Lake Habbema and Kali Oue Valley around Mt. Trikora (= Mt. Wilhelmina) (Fig. 14).

Differential diagnosis. *L. konoensis* sp. nov. is a medium sized (TL = 2.3–2.5 mm) and almost blackish high alpine species. The new species is close to *L. alexanderi*, *L. juliana* sp. nov., *L. moni* and *L. habbema* sp. nov. but can be separated from them by its smaller size, and the form of the female antennae (female with regularly enlarged antennomeres in *L. moni*), which is stout but without any conspicuous modifications (Fig. 2C), the form of the median lobe (Fig. 8A), and the form of the parameres (Figs 10F, 11D).

Habitat. Small puddles in alpine meadows (Figs 16C, 17B, C, D, 18D, E).

Limbodessus wilhelmina sp. nov.

https://zoobank.org/BE79780D-1DB9-4B27-B9A2-01D358C9C49E

Figs 2A, 7C, 10A, B, 11C, 12A, B, 13D, 14, 16C

Type locality. Mossy puddles in Alpine grassland, Lake Habbema, 3,200 m [4°07'77S, 138°40'77E], Papua, Indonesia.

Type material. ***Holotype***, male: "Indonesia, Papua, Lake Habbema, pools, 3200m, 19.x.2011, 04.07.772S 138.40.773E, team UNCEN leg. (PAP06)", "Holotype *Limbodessus wilhelmina* sp. nov. Balke et al. 2025" [red printed label] (MZB).

Figure 7. Median lobes ventral and lateral of: *L. aipo* sp. nov. (**A**); *L. elit* sp. nov. (**B**); *L. wilhelmina* sp. nov. (**C**); *L. juliana* sp. nov. (**D**). Scale bar: 0.5 mm.

Figure 8. Median lobes ventral and lateral of: *L. konoensis* sp. nov. (**A**); *L. moni* (**B**); *L. alexanderi* (**C**); *L. habbema* sp. nov. (**D**). Scale bar: 0.5 mm.

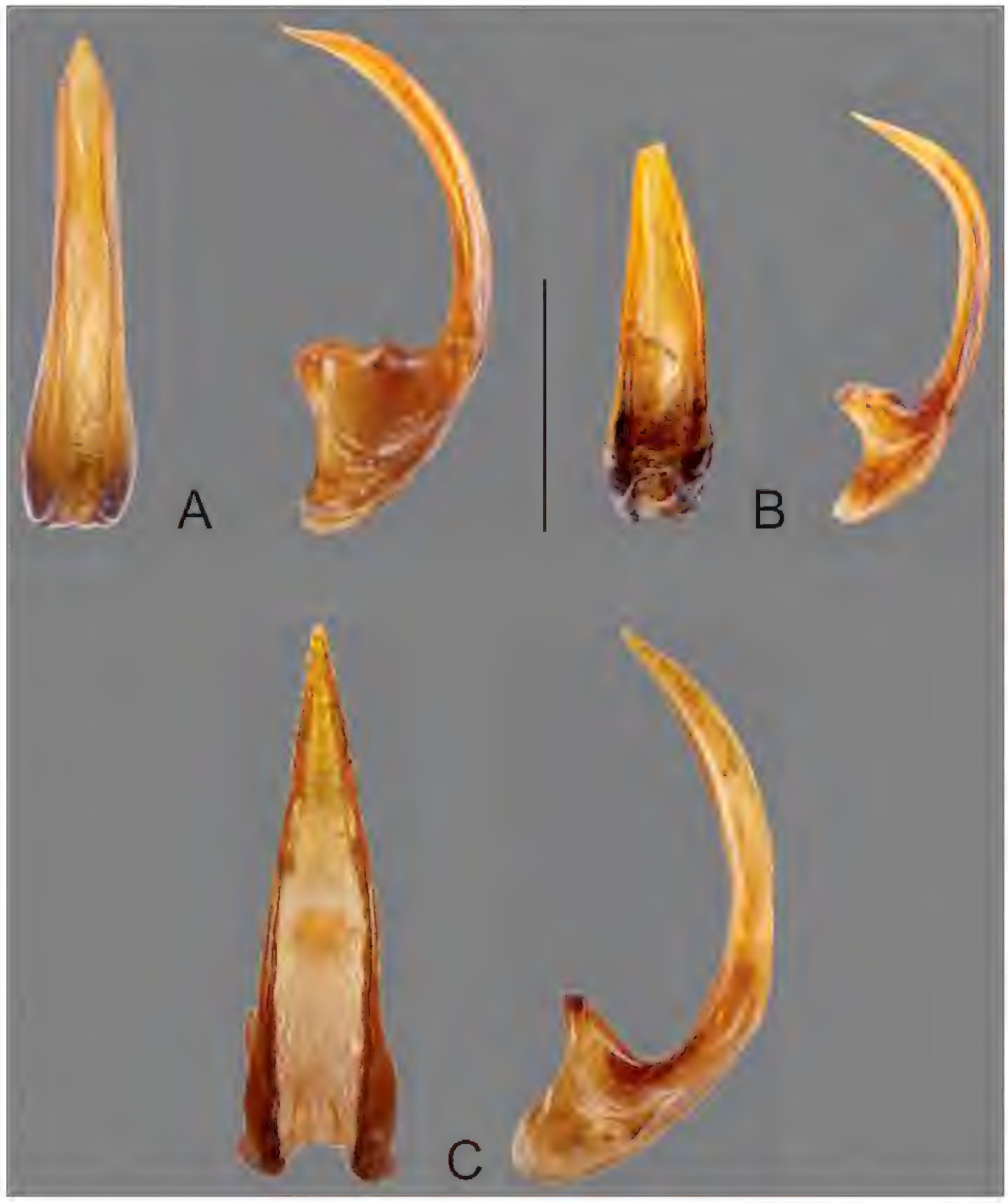

Figure 9. Median lobes ventral and lateral of: *L. baliem* (**A**); *L. paniai* sp. nov. (**B**); *L. skalei* (**C**). Scale bar: 0.5 mm.

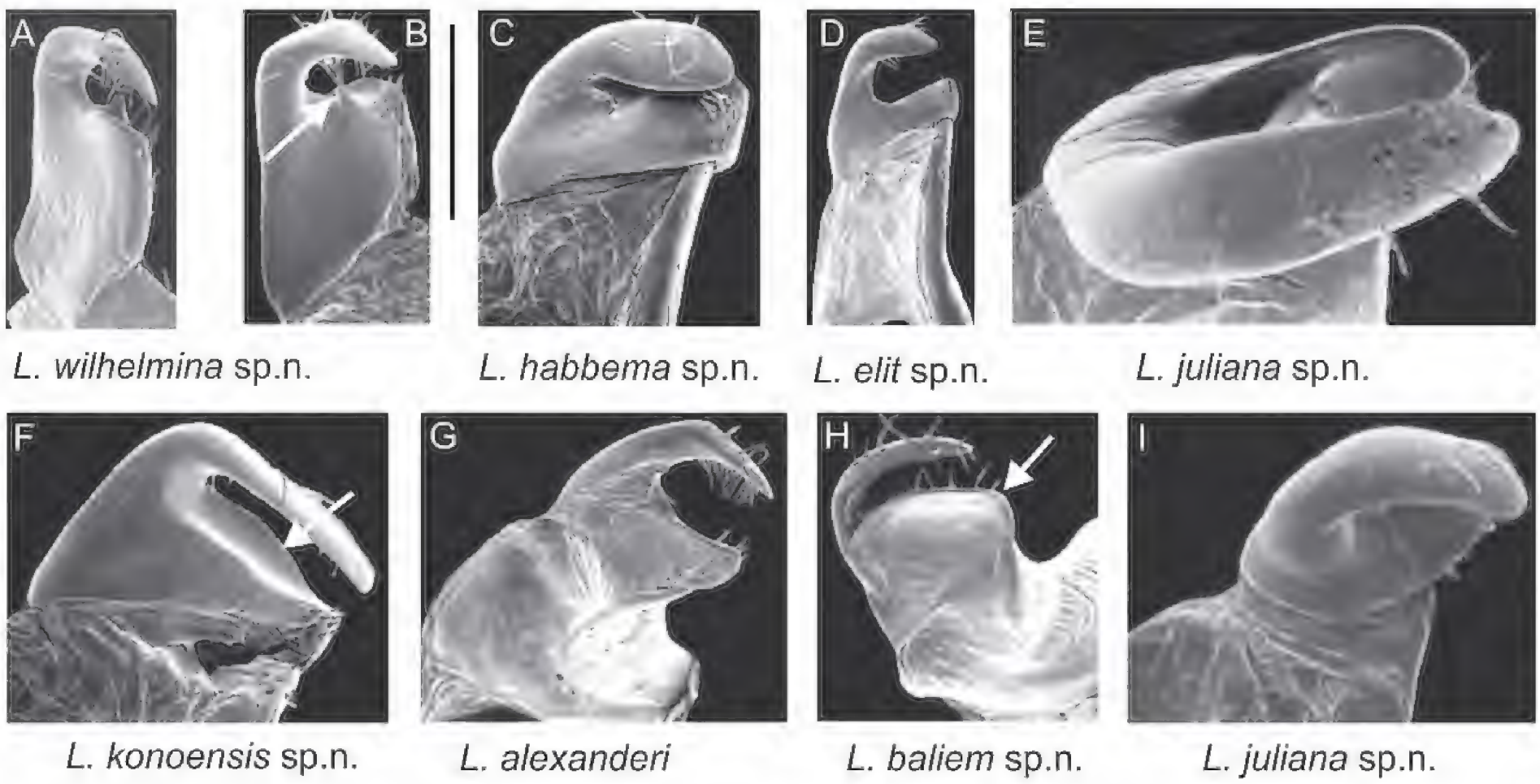

Figure 10. Upper third of the right parameres, lateral view of: *L. wilhelmina* sp. nov. (**A, B**); *L. habbema* sp. nov. (**C**); *L. elit* sp. nov. (**D**); *L. juliana* sp. nov. (**E**); *L. konoensis* sp. nov. (**F**); *L. alexanderi* (**G**); *L. baliem* (**H**); *L. juliana* sp. nov. (**I**). Scale bar: 0.2 mm.

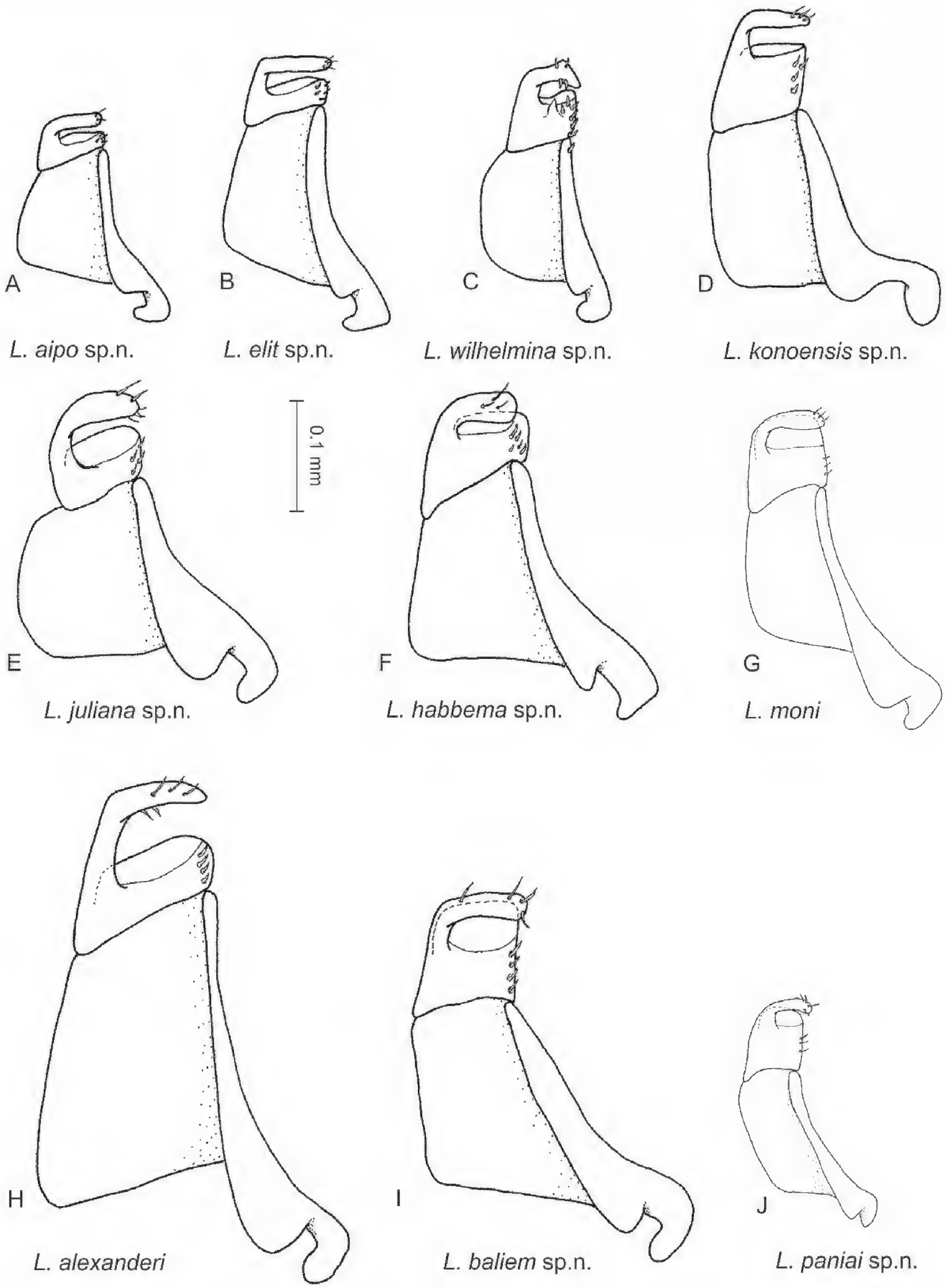

Figure 11. Right parameres (inner side), lateral view of: *L. aipo* sp. nov. (**A**); *L. elit* sp. nov. (**B**); *L. wilhelmina* sp. nov. (**C**); *L. konoensis* sp. nov. (**D**); *L. juliana* sp. nov. (**E**); *L. habbema* sp. nov. (**F**); *L. moni* (**G**); *L. alexanderi* (**H**); *L. baliem* (**I**); *L. paniai* sp. nov. (**J**). Scale bar: 0.1 mm.

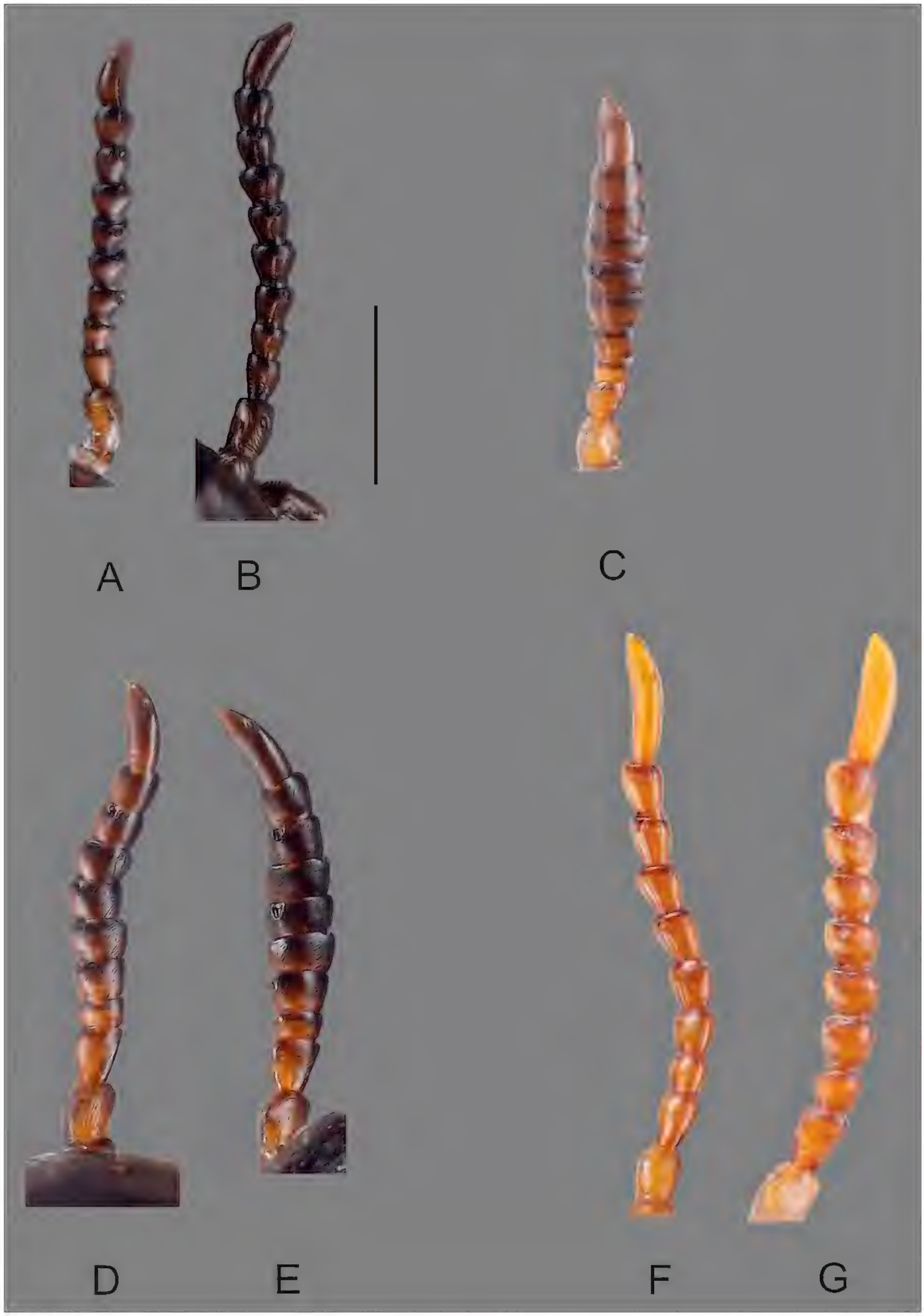

Figure 12. Antennae of: *L. wilhelmina* sp. nov., male (**A**); *L. wilhelmina* sp. nov., female (**B**); *L. aldente* sp. nov., female (**C**); *L. habbema* sp. nov., female, with less extended antennomeres (**D**); *L. habbema* sp. nov., female, with extended antennomeres (**E**); *L. baliem*, male (**F**) and *L. baliem*, female (**G**). Scale bar: 0.25 mm.

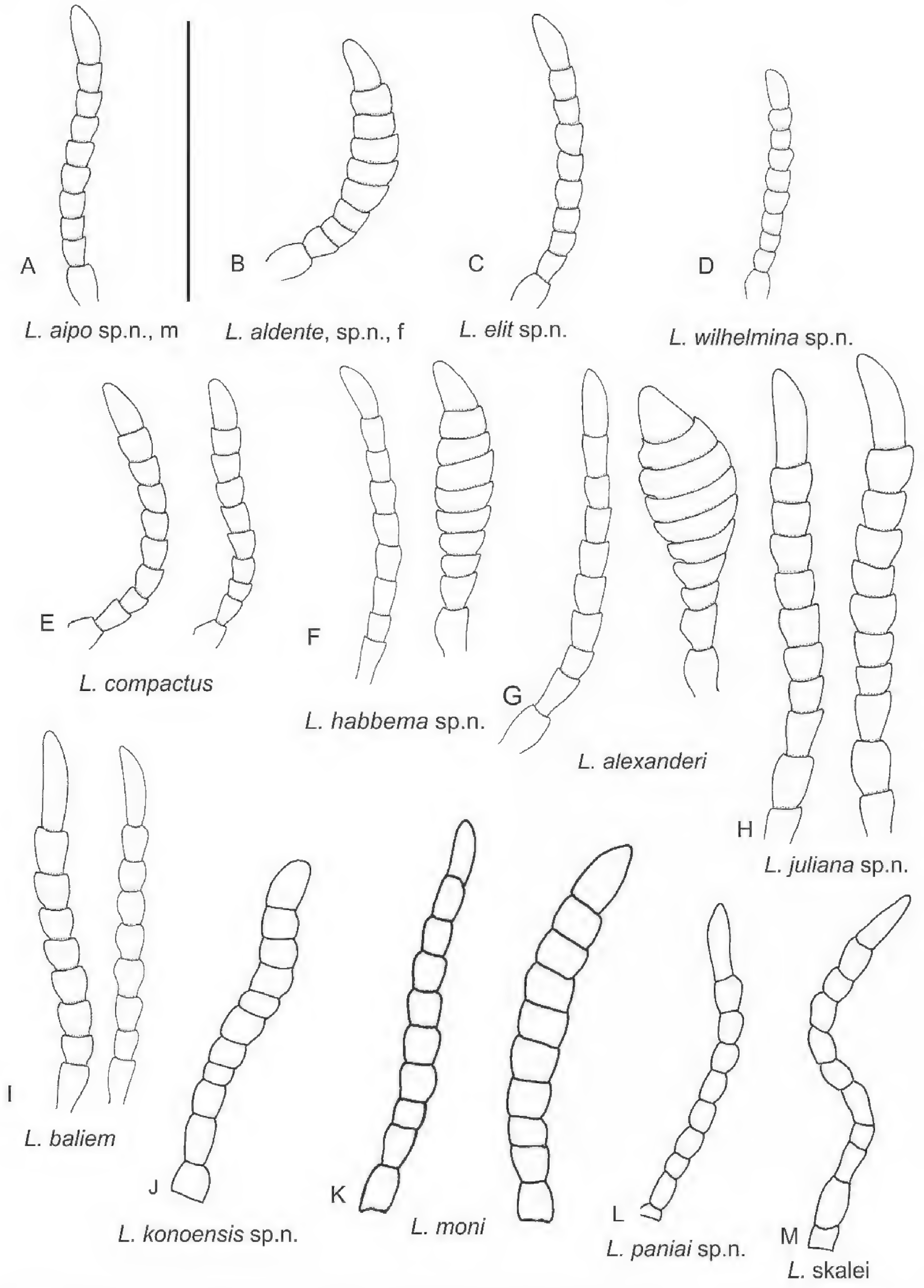

Figure 13. Antennae of: *L. aipo* sp. nov., male (**A**); *L. aldente* sp. nov., female (**B**); *L. elit* sp. nov., female (**C**); *L. wilhelmina* sp. nov., male (**D**); *L. compactus*, male, female (**E**); *L. habbema* sp. nov., male, female (**F**); *L. alexanderi*, male, female (**G**); *L. juliana* sp. nov., male, female (**H**); *L. baliem*, female, male (**I**); *L. konoensis* sp. nov., female (**J**); *L. moni*, male, female (**K**); *L. paniai* sp. nov., male (**L**) and *L. skalei*, male (**M**). Scale bar: 0.5 mm.

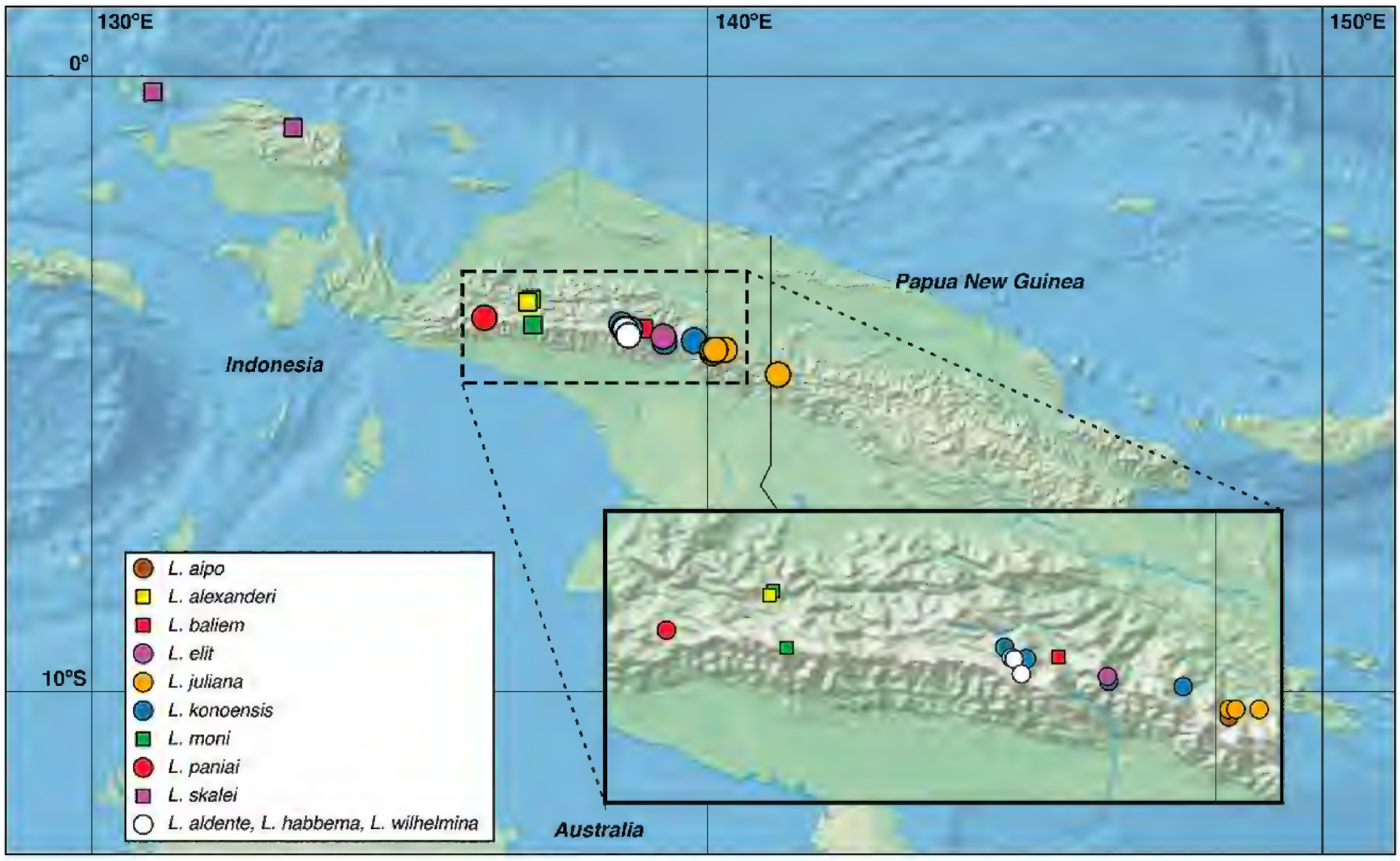

Figure 14. Distribution of *Limbodessus* in New Guinea. The lowland species *L. compactus* can be expected along the shore of the whole island up to 500 m.

Paratypes (632): 182 exs., with the same label data as the holotype (MZB, KSP, ZSM); 395 exs. "IRIAN JAYA: Trikora Gebiet 19.-20.10.1993, Habbema [Lake] and Kali Oue Tal [Valley], ca. 138°43'E 04°13'S, 3450m, leg. M. Balke (39)" [IR93#39] (MZB, NHMW, KSP, ZSM); 22 exs., "Irian Jaya: 18.10.1993 Trikora Area Fuß des Mt. Trikora, ca. 138°43'E 04°13'S, 3200m, leg. M. Balke (38)" [IR93#38] (NHMW, ZSM); 3 exs., "Irian Jaya, Wamena E, Habbema lake, 4°07'S 138°40'E, 20.1.1999, leg. A. Weigel" (ZSM); 27 exs., "INDONESIA, Papua: Jayawijaya Distr., ca. 30 km W of Wamena, open wetland nr Habbema lake, 04°07.8'S, 138°40.7'E; 3330 m, J.Hájek & J.Šumpich leg., 5.ii.2015" (NMPC); 2 exs., "Indonesia, West Papua, Highland near Lake Habbema, Sphagnum-pools near the road, 3451m, 4°06'32.8"S 138°38'54.2"E, 09.06.2022, N. Wendlandt leg." (CNW, ZSM). All paratypes are provided with a red printed paratype label.

Measurements. Holotype: TL = 1.8 mm; TL-H = 1.65 mm; MW = 0.85 mm. Paratypes: TL 1.7–1.9 mm, TL-H = 1.6–1.75 mm; MW = 0.85–0.9 mm.

Description. Small, body oblong-oval, with distinct discontinuity in lateral outline between pronotum and elytron. Cervical or sutural line absent. Pronotal and elytral stria present and distinct (Fig. 2A).

Color. Body chiefly black. Clypeus anteriorly, pronotum laterally slightly paler, castaneous brown. Antenna almost completely blackish. Legs dark ferruginous to blackish (Fig. 2A). Ventral side chiefly black. Prosternum, epipleura and sternite 7 ferruginous.

Sculpture. Head comparably densely punctate; punctation apically sparse; with indistinct microreticulation of small polygonal meshes. Size of punctures corresponds to diameter of meshes. Pronotum shiny; rather sparse and fine punctation; slightly denser and coarser along fore-margin; without microreticulation. Elytron with moderately dense and evenly distributed punctation; size of punctures as on head or slightly larger; between punctures with large, indistinct polygonal meshes. Ventral side with few punctures, shiny; only sternite 7 with distinct microreticulation.

Structures. Metacoxal lines anteriorly diverge and do not reach posterior margin of metaventrite.

Male. Elytron shiny, without visible microreticulation between punctures. Antenna stout (Fig. 13D). Median lobe as in Fig. 7C and parameres as in Figs 10A, B, 11C.

Female. Elytron shiny, without visible microreticulation between punctures. Antenna stout but without conspicuous modifications (Fig. 12A, B).

Etymology. Named after the highest peak in the type area, Mount Wilhelmina (the historic name of what is nowadays known as Mt. Trikora). The name is a noun in the nominative standing in apposition.

Distribution. Only known from the Lake Habbema area, in the Central Highlands of Papua (Fig. 14).

Differential diagnosis. *Limbodessus wilhelmina* sp. nov. belongs to a group of smaller (TL = 1.55–1.9 mm) and almost blackish high alpine species. The new species is close to *L. aipo* sp. nov., *L. aldente* sp. nov. and *L. elit* sp. nov. but can be separated from them by the form of the female antennae, which is stout without any conspicuous modifications (Fig. 12A, B), the form of the median lobe (Fig. 7C), and the form of the parameres (Figs 10A, B, 11C).

Habitat. Small puddles in alpine meadows (Fig. 16C).

Figure 15. Kapupaten Paniai, Paniai Lakes (=Wisselmeeren), Enarotali (**A**); Silting zone of Lake Paniai, with mats of floating vegetation (**B, D**). Beetles among sun exposed floating mats of grasses. Type locality of *L. paniai* sp. nov. (**C**) (Photos: L. Hendrich); Wamena, small puddle of an old drainage ditch (**E**) and larger rest pool of small river (**F**), habitat of *L. baliem* (Photos: M. Balke).

***Limbodessus paniai* sp. nov.**

https://zoobank.org/8A4935ED-EE2C-453A-9D5D-FF27A9F79C25

Figs 5C, 9B, 11J, 13L, 14, 15C

Type locality. Mats of floating grasses, Enarotali, Lake Paniai, 1,900 m [3°55'16S, 136°22'33E], Papua, Indonesia.

Type material. ***Holotype***, male. "IR 25- W. New Guinea, Enarotali [Bobairo], Danau Paniai, 1900 m, 29.vii.-4.viii.1991, Balke & Hendrich leg." [IR 91#25], "Holotype *Limbodessus paniai* sp. nov. Balke et al. 2025" [red printed label] (NHMW).

***Paratype*:** 1 female with the same label data as the holotype (ZSM). The paratype is provided with a red printed paratype label.

Measurements. Holotype: TL = 2.1 mm; TL-H = 2.0 mm; MW = 1.0 mm. Paratype: TL = 2.05 mm; TL-H = 2.0 mm; MW = 1.0 mm.

Description. Small, body oblong-oval, somewhat parallel-sided, with almost no discontinuity in lateral outline

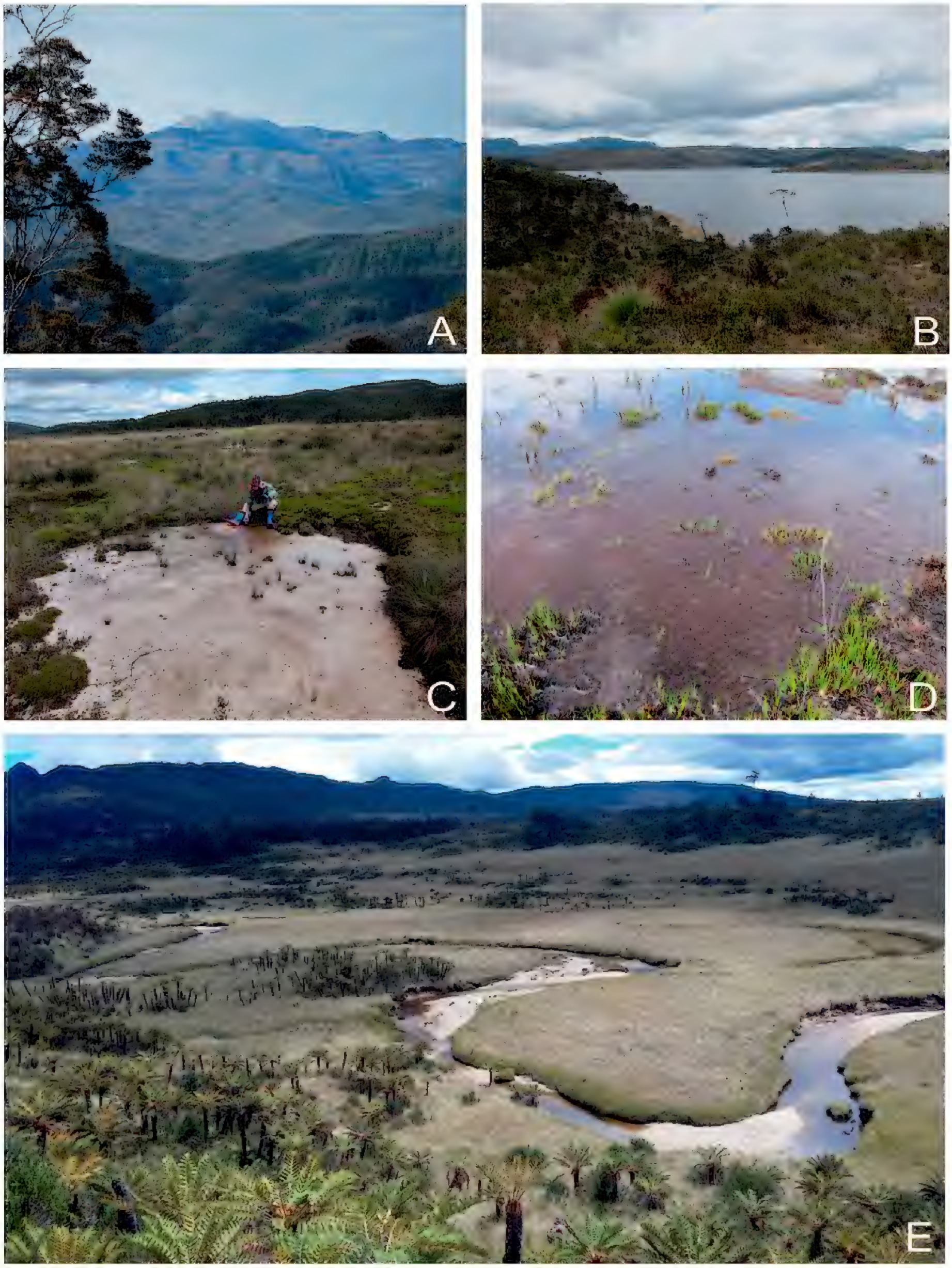

Figure 16. Central Highlands, view of Mount Wilhelmina (= Trikora) from the North (**A**); Lake Habbema (**B**); Typical shallow water habitats on white sandy substrate partially with peat in Lake Habbema area. Habitat of *L. habbema* sp. nov., *L. wilhelmina* sp. nov. and *L. konoensis* sp. nov. (**C**), as in C, with peaty bottom (**D**); Wamena River (locals called it Oue Valley), north of Mt. Wilhelmina. In shallow peaty pools and puddles along the valley, *L. konoensis* sp. nov. can be found (**E**) (Photos: M. Balke).

between pronotum and elytron. A faint cervical line visible; sutural line absent. Pronotal and elytral stria present and distinct, both straight; elytral stria short (Fig. 5C).

Color. Head dark brown, clypeus paler, ferruginous. Pronotum yellow. Elytron darker yellowish. Body appendages yellow (Fig. 5C). Prosternum, epipleura and

Figure 17. Central Highlands, view of Mount Elit (**A**); small peatland ponds in open and forested areas below Mount Elit, habitat of *L. elit* sp. nov. and *L. konoensis* sp. nov. (**B, C, D**); track from Aipo to Langda (**E**); small, very shallow and exposed peatland puddles, surrounded by mosses and sedges, habitat of *L. aipo* sp. nov. and *L. juliana* sp. nov. (**F, G**), and near Nalca (Mt. Orom), habitat of *L. konoensis* sp. nov. (**H**) (Photos: M. Balke).

Figure 18. Central Highlands, "Valley of the Lakes", below Mt. Juliana, peaty, shallow lake, habitat of *L. juliana* sp. nov. (**A**); view from Mount Juliana (**B**); swamp forest below Mt. Juliana (**C**); shallow pools and puddles below Mt. Juliana, where *L. konoensis* sp. nov. can be found (**D, E**) (Photos: M. Balke).

ventrites posteriorly yellow. Mesoventrite dark ferruginous to blackish.

Sculpture. Head with sparse, coarse punctation; posterior of cervical line impunctate but with microreticulation. Pronotum with moderately dense punctation along anterior margin; otherwise faint and sparse, almost impunctate; punctures however rather shallow giving the pronotum an exceptionally smooth and shiny impression. Elytron with moderately dense and evenly distributed punctation; punctures rather shallow rendering elytron comparably smooth. Ventral side with few punctures only.

Structures. Metacoxal lines anteriorly diverge and do not reach posterior margin of metaventrite.

Male. Elytron shiny, without visible microreticulation between punctures. Antenna stout (Fig. 13L). Median lobe as in Fig. 9B and parameres as in Fig. 11J.

Female. Elytron dull, with distinct microreticulation between punctures. Antenna stout but without conspicuous modifications.

Etymology. Named after the type locality, Lake Paniai (= Wisselmeren). The name is a noun in the nominative standing in apposition.

Distribution. Only known from the type locality (Fig. 14).

Differential diagnosis. The new species can be easily separated from most of the other New Guinean *Limbodessus* by its yellowish dorsal surface without any dark markings (Fig. 5C). *Limbodessus paniai* sp. nov. is close to *L. baliem* (Fig. 5A, B) but can be separated by its smaller size (*L. paniai* sp. nov. = 2.0–2.1 mm; *L. baliem* = 2.6–3.0 mm], the form of the median lobe (Fig. 9B), and the form of the parameres (Figs 10H, 11I, J).

Habitat. Both specimens were collected in very shallow water, among sun exposed floating mats of grasses, at the edge of the large Paniai lake near the village Enarotali (Fig. 15A–D). The species was associated with numerous *Rhantus ekari* Balke & Hendrich, 1992, the most common diving beetle in that habitat (Balke and Hendrich 1992).

Other species studied

Limbodessus alexanderi Balke & Hendrich, 2015

Limbodessus alexanderi Balke & Hendrich in Balke et al. 2015: 4 (original description); Hendrich et al. 2020: 590 (key); Surbakti et al. 2023: 417 (descr., key).

Material examined. ***Paratypes*:** 10 exs., "Indonesia, Papua; N Sugapa 3000m, 3°40'11.90"S, 137° 4'51.31"E, 27.xii.1995, Riedel leg."; 4 exs. with green labels: "M. Balke 4424, 4425, 6423, 6424" (MZB, ZSM).

Morpholog. Habitus: Male (Fig. 1B) and female (Fig. 2B).

Antennae: Male and female (Fig. 13G).

Median lobe (Fig. 8C) and paramere (Figs 10G, 11H).

Distribution. Indonesian New Guinea, known only from the type locality at 3,000m, which is the mountain range north of Sugapa, Papua (Balke et al. 2015) (Fig. 14).

Limbodessus baliem Balke & Hendrich, 2015

Limbodessus alexanderi Balke & Hendrich in Balke et al. 2015: 25 (original description); Hendrich et al. 2020: 590 (key); Surbakti et al. 2023: 420 (key).

Material examined. ***Paratypes*:** 15 exs., "New Guinea Wamena 1600m; 4°6'16.76"S, 138°57'37.96"E; 31.viii. & 6.ix.1990; leg. Balke & Hendrich (IR1)" (CLH, ZSM).

Morphology. Habitus: Male (Fig. 5A) and female (Fig. 5B).

Antennae: Male and female (Fig. 12F, 12G, 13I).

Median lobe (Fig. 9A) and paramere (Figs 10H, 11I).

Distribution. Indonesian New Guinea, known only from the Baliem Valley, which also contains the type locality Wamena (Figs 14, 15E, F).

Limbodessus compactus (Clark, 1862)

Hydroporus compactus Clark, 1862: 421 (original description); Biström 1988: 16 (descr.); Guignot 1939: 53 (N. COMB.).

Bidessus neoguineensis Régimbart, 1892: 990 (original description); Balke and Satô 1995: 188 (N. SYN.).

Uvarus tokarensis Satô, 1972: 53 (original description); Balke and Satô 1995:188 (N. SYN.).

Limbodessus compactus (Clark, 1862): Hendrich et al. 2020: 590 (key).

Material examined. 2 exs., "Papua New Guina: Central Woitape, 1500m, i.2008, 33.178S 15.481E, Posman (PNG 167)" (ZSM); 5 exs., "Indonesia: Papua, Merauke, Wasur, pools, 20m, 15.-16.x.2011, 14 42.748S 141 36.096E, UNCEN team" (Pap02) (KSP, ZSM).

Morphology. Habitus: Male (Fig. 5D).

Antennae: Male and female (Fig. 13E).

Distribution. South East Asia and widespread in the Australasian realm. On New Guinea *L. compactus* is widespread especially in the lowlands, it is absent from the Baliem Valley and altitudes above 2,000 m (Balke et al. 2015).

Limbodessus moni Surbakti, Balke & Hendrich, 2023

Limbodessus moni Surbakti, Balke & Hendrich, 2023: 414 (original description).

Type material. ***Holotype*:** Male, "Indonesia: Papua, Grasberg, 3,970, viii.2018, -4.0447° 137.167°, Surbakti", "HOLOTYPE / *Limbodessus moni* sp. nov./ Surbakti, Balke & Hendrich det. 2023" [red printed label] (MZB). ***Paratypes*:** Three males and one female with the same data as the holotype (MZB, KSP). 9 males and 2 females: "Indonesia, Irian Jaya, Lake Anderson [3,555 m] nr Grasberg, 23.iii.1997, D. Polhemus" (USNM, ZSM).

Additional material examined. 1 female that, based on the overall morphology, appears to also belong to *L. moni*. "Indonesia, Papua; N Sugapa 3000m, 3°40'11 S, 137°4'51 E, 27.xii.1995, Riedel leg."

Morphology. Habitus: Male (Fig. 4C) and female (Fig. 4B).

Antennae: Male and female (Fig. 13K).

Median lobe (Fig. 8B) and paramere (Fig. 11G).

Distribution. Known only from two localities around the Grasberg Mine and Anderson Lake (Carstenz Pyramid area), between 3,555 and 3,970 m, in Papua (Fig. 14).

Limbodessus skalei Hendrich, Surbakti & Balke, 2020

Limbodessus skalei Hendrich, Surbakti & Balke, 2020: 588 (original description); Surbakti et al. 2023: 420 (key).

Type material. ***Holotype*:** Male, "Indonesia, W-Papua, Raja Ampat Prov., Waigeo, Werabiai River, 197m**,** -0.258519° 130.985685°, 11.1.2004", "HOLOTYPE *Limbodessus skalei* sp. nov. Hendrich & Balke det. 2019" [red printed label] (MZB). ***Paratypes*:** One male and one female with the same data as the holotype (ZSM).

Additional material examined. 1 ex., "Indonesia: West Papua, Kebar valley, 596m, 6.v.2015, -0, 8406 133,2682, Panjaitan et al. (BH059)" (KSP). First record of the species for New Guinea.

Morphology. Habitus: Male (Fig. 6A) and female (Fig. 6B).

Antennae: Male and female (Fig. 13M).

Median lobe (Fig. 9C).

Distribution. Known from the type locality on Waigeo Island (Hendrich et al. 2020) and Bird's Head Peninsula (Vogelkop) of New Guinea (Fig. 14).

Modified key to species of *Limbodessus* from New Guinea (after Balke et al. 2015, Hendrich et al. 2020 and Surbakti et al. 2023)

1 Base of elytral epipleuron with raised transverse carina delineating a basal pit (see fig. 36 in Balke et al. 2015) (widespread in Australasian region; ventral aspect as in fig. 28, with metaventrite and metacoxa rather smooth; male genitalia as in figs 32, 33, 35) ..... *Limbodessus compactus* (Clark, 1862)

– Base of elytral epipleuron without raised transverse carina delineating a basal pit (see fig. 38 in Balke et al. 2015).... 2

2 Yellowish species with or without any blackish markings on elytra 3

– Dark-brown to blackish species 5

3 Larger species (TL = 2.6–3.0 mm), elytral plicae distinct and long, mainly yellowish without distinct markings on elytra. Male shiny (Fig. 5A), female mat with strong microreticulation (Fig. 5B). Endemic of Baliem Valley in Papua..... ..... *Limbodessus baliem* Balke & Hendrich, 2015

– Smaller species (TL = 2.0–2.1 mm), elytral plicae short 4

4 Yellowish with distinct markings on elytra (Fig. 6A, B). Elytral plicae curved inwards. TL = 2.0–2.1 mm. Male and female shiny without microreticulation on elytra. Island of Waigeo and Vogelkop Area in Papua .... *Limbodessus skalei* Hendrich, Surbakti & Balke, 2020

– Yellowish, without any markings on elytra (Fig. 5C). Elytral plicae straight, TL = 2.05–2.1 mm. Male shiny, female mat with microreticulation. Paniai Lakes, Papua ..... *Limbodessus paniai* sp. nov.

5 Larger species (TL = 2.25–3.0 mm) 6

– Smaller species (TL = 1.55–1.90 mm) 10

6 Elytral plicae absent 7

– Elytral plicae short and curved inwards 8

7 Females with strongly enlarged antennomeres forming a conspicuous club (Fig. 2B). TL = 2.6–3.0 mm. Median lobe as in Fig. 8C. Only known from high altitude grassland north of Sugapa, Papua..... ..... *Limbodessus alexanderi* Balke & Hendrich, 2015

– Female antennomeres simple (Fig. 13H). TL = 2.6–2.7 mm. Median lobe as in Fig. 7D. Papua: Mt. Juliana, Aipomek; Papua New Guinea: Mt Capella area ..... *L. juliana* sp. nov.

8 Antennomeres of female simple and not enlarged (Fig. 13J). TL = 2.35–2.5 mm. Median lobe as in Fig. 8A. Papua: Kono area, Mt. Elit, Lake Habbema area ..... *L. konoensis* sp. nov.

– Antennomeres of female enlarged (Figs 3B, C, 12D, 13E). TL = 2.25–3.0 mm 9

9 Larger species: TL = 2.25–3.0 mm. Median lobe as in Fig. 8D. Papua: Lake Habbema area ..... *L. habbema* sp. nov.

– Smaller species: TL = 2.25–2.7 mm. Antennomeres 4–11 of female only slightly enlarged (Fig. 13K). Median lobe as in Fig. 8B. Only known from high altitude grassland of Carstenz Pyramid area, Papua .... *Limbodessus moni* Surbakti, Balke & Hendrich, 2023

10 Elytral plicae weak and short. Female antennomeres strongly enlarged (Fig. 13B). TL = 1.80–1.90 mm. Male unknown. Papua: Lake Habbema..... *L. aldente* sp. nov.

– Elytral plicae well developed but very short as in Figs 3B, C, 4B. Female antennomeres simple and not enlarged (Fig. 13A, C, D) 11

11 Smallest species of the genus in New Guinea. TL = 1.55–1.70 mm. Median lobe as in Fig. 7A. Papua: Aipomek and Kono Highlands ..... *L. aipo* sp. nov.

– Larger species (TL = 1.70–1.90 mm)..... 12

12 Body stout and more parallel sided (Fig. 1D). TL = 1.70–1.85 mm. Median lobe as in Fig. 7B. Papua: Mt. Elit ..... *L. elit* sp. nov.

– Body more elongate (Fig. 2A). TL = 1.70–1.90 mm. Median lobe as in Fig. 7C. Papua: Lake Habbema area ..... *L. wilhelmina* sp. nov.

Conclusion

In conclusion, the discovery of *Limbodessus* diving beetles in the New Guinea Highlands highlights the region's remarkable biodiversity and the potential for further scientific exploration. Given the vast, unsampled highland areas, especially in the eastern part, in Papua New Guinea, additional fieldwork is likely to uncover more undescribed species, contributing to a deeper understanding of aquatic beetle diversity and tropical alpine ecosystems. Continued research and conservation efforts will be essential to documenting and preserving this unique fauna.

Acknowledgements

We acknowledge support from the SNSB-Innovative scheme (Project: Revealing the World's highest elevational gradient), funded by the Bayerisches Staatsministerium für Wissenschaft und Kunst. This work was also supported with funds from the "Bayerischer Pakt für Forschung und Innovation (BayPFI)" (to M. Balke, setting up digitisation infrastructure). The work of J. Hájek was supported by the Ministry of Culture of the Czech Republic (DKRVO 2024-2028/5.I.b, National Museum, 00023272). Yannick Chittaro (Neuchâtel, Switzerland), Helena Shaverdo (Vienna, Austria), Mariano Michat (Buenos Aires, Argentina), and Kelly B. Miller (Albuquerque, New Mexico, USA) are thanked for critically reviewing the manuscript.

References

Balke M, Hendrich L (1992) Ein neuer *Rhantus* Dejean aus West-Neuguinea (Coleoptera: Dytiscidae). Entomologische Zeitschrift 102(3): 37–39.

Balke M, Satô M (1995) *Limbodessus compactus* (Clark): A widespread Austro-Oriental species, as revealed by its synonymy with two other species of Bidessini (Coleoptera: Dytiscidae). Aquatic insects 17(3): 187–192. https://doi.org/10.1080/01650429509361586

Balke M, Ribera I (2004) Jumping across Wallace's line: *Allodessus* Guignot and *Limbodessus* Guignot revisited (Coleoptera: Dytiscidae, Bidessini) based on molecular-phylogenetic and morphological data. Australian Journal of Entomology 43(2): 114–128. https://doi.org/10.1111/j.1440-6055.2004.00415.x

Balke M, Ruthensteiner B, Warikar E, Neven K, Hendrich L (2015) Two new species of *Limbodessus* diving beetles from New Guinea – short verbal descriptions flanked by online content (digital photography, µCT scans, drawings and DNA sequence data). Biodiversity Data Journal 3: e7096. https://doi.org/10.3897/BDJ.3.e7096

Biström O (1988) Generic review of the Bidessini (Coleoptera, Dytiscidae). Acta Zoologica Fennica 184: 1–41.

Eberhard SM, Watts CHS, Callan SK, Leijs R (2016) Three new subterranean diving beetles (Coleoptera: Dytiscidae) from the Yeelirrie groundwater calcretes, Western Australia, and their distribution between several calcrete deposits including a potential mine site. Records of the Western Australian Museum 31: 27–40. https://doi.org/10.18195/issn.0312-3162.31(1).2016.027-040

Guignot F (1939) Contribution à l'étude des *Bidessus*. Bulletin de la Société d'Étude des Sciences Naturelles de Vaucluse 10(4): 51–61.

Hendrich L, Surbakti S, Balke M (2020) *Limbodessus skalei* sp. nov., a new diving beetle species from the west Papuan Archipelago (Coleoptera: Dytiscidae, Bidessini). Zootaxa 4763(4): 587–592. https://doi.org/10.11646/zootaxa.4763.4.8

Miller KB, Nilsson AN (2003) Homology and terminology: Communicating information about rotated structures in water beetles. Latissimus 17: 1–4.

Nilsson A Hájek J (2024) A world catalogue of the family Dytiscidae, or the diving beetles (Coleoptera, Adephaga). Version 1. I. 2024, 323 pp. [Distributed as a PDF file via Internet] http://www.waterbeetles.eu/documents/W_CAT_Dytiscidae_2024.pdf

Ordish RG (1966) A systematic revision of the New Zealand water beetles (Coleoptera: Dytiscidae). Records of the Dominion Museum 5(22): 217–264.

Régimbart M (1892) Viaggio di Lamberto Loria nella Papuasia orientale. IV. Haliplidae, Dytiscidae et Gyrinidae. Annali del Museo Civico di Storia Naturale, Genova (2) 10(30)(1890-1891): 978–997.

Surbakti S, Balke M, Hendrich L (2023) *Limbodessus moni* sp. nov., a new high altitudinal diving beetle from the Grasberg in West Papua, Indonesia (Coleoptera: Dytiscidae, Bidessini). Zootaxa 5319(3): 413–420. https://doi.org/10.11646/zootaxa.5319.3.7

Villastrigo A, Cooper SJB, Langille B, Fagan-Jeffries EP, Humphreys WF, Hendrich L, Balke M (2024) Aridification and geotectonic landscape change shaped an extraordinary species radiation across a world's extreme elevational gradient. Communications Biology 7: 1500. https://doi.org/10.1038/s42003-024-07181-7

Watts CHS, Leijs R (2005) Review of the epigean species of Australian *Limbodessus* Guignot (Insecta: Coleoptera: Dytiscidae). Transactions of the Royal Society of South Australia 129(1): 1–13.